Acquisition, transfer and data management for agriculture

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Agriculture: new challenges

- New challenges for modern agriculture:
  - Less land and increasing needs
    - Demographic growth / Animal proteins diets
  - New uses for crop biomass
    - Ethanol / Energy / Green chemistry / Textile fibers
  - Environmental issues: soil / water / crops
    - Larger urban zones / health issues / Soil / Resources

Producing more with less
Farmer's constraints

- Cost reduction and labor requirements
- More efficient use of inputs (nutrients, pesticides, irrigation water)
- Yield
- Crop quality improvement
- Production tracking for food safety and environmental benefits

Main goal: economic return on investment
A Management System that is information and technology based, is site specific and uses one or more of the following sources of data: soils, crops, nutrients, pests, moisture, or yield, for optimum profitability, sustainability, and protection of the environment.
The Soil: culture substrate?

- **A finite resource**: No intensive agriculture or productivity without soil.

- **Soil FERTILITY**: Completing biogeochemical cycles (C; N; P).

- **Soil HEALTH**: Physico-chemical / biological parameters.

**Heterogeneity**

- Water
- Nutrients
- Biological engine
- Soil structure

**Inputs efficiency**

- Nutrients
- Pesticides
- Irrigation water

**Itinerary of culture and parcel history**
The Soil: culture substrate?

Heterogeneity

Soil FERTILITY
Soil HEALTH
Inputs efficiency

Itinerary of culture
Parcel history

Water
Nutrients
Biological engine
Soil structure

Too many variables

Need to monitor

What and how to monitor?
For what Purpose?

Economic and production considerations
Decision tools for a better end-user economic performance

1. DATA ACQUISITION In Field
   - Grid of sensors and probes for directed sampling
   - Sensors specificity and sensitivity
   - Autonomy
   - How deep?

2. DATA MONITORING and TRANSFER
   - Linking the sensors
   - Data readings
   - Data transfer: real time?

3. DATA PROCESSING
   - Background data
   - Recordkeeping system
   - Analysis and decision making process

4. RECOMMENDATION and USE ADVICE
   - Specialized implementation equipment
   - Evaluation and revision
Technological barriers

1. **Sensors and probes**: not **specific** and not **sensitive** enough; **integration** of different sensors in the same probes; ...
   - Nutrients: Nitrogen ≠ Phosphate
   - Pesticides and pesticide residues
   - Water (Agralis probes)
   - Soil life / plant health

2. **Sensors and probes**: **cost** and industrial mass production
   ⇒ how many sensors / Ha
   ⇒ how precise is the data acquisition and monitoring
Water monitoring (Agralis)

Capacitive sensors: 1 to 5 / probe; 10 to 50 cm / capacitors
Jours de stress par manque d’air

Début de Stress

Irrigation

Stress par manque d’eau
3. Data processing and use recommendation:
   • huge amount of data can be collected / Ha \(\Rightarrow\) how to process / compare / learn / interact / model / predict
   • and of course deliver a simple specific accurate and usable information to the farmer

   • Work in progress for the physico-chemical aspects, but very little for the biological interactions and parameters.
Thank you